Current Long Duration Balloon Support

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ULDB Mission Operations

SIP (Support Instrument Package)

- **COMM 1**
  - **TDRSS (Mid latitudes - 2 kbps MA / 5 kbps SA)**
    (Polar - 4 kbps MA / 8 kbps SA) OR
  - **HF (Commanding) / Argos (TM)**
- **COMM 2**
  - **INMARSAT-C (512 bytes / 15 minutes) / Argos (Housekeeping TM)**
- **Each COMM System Incorporates:**
  - » **Flight Computer**
    - **TM data acquisition / formatting**
    - **Command routing / execution**
    - **Balloon control**
    - **Science instrument interface for TM and Commanding**
    - **Data archive for entire mission (playback on TDRSS side)**
  - » **GPS and Pressure Altitude Sensors**
  - » **Housekeeping / Command Stacks**
  - » **LOS (L/S Band) TM and LOS UHF Commanding**
  - » **Passive / Active Thermal Controls**

Photo Voltaic Power System

- **Two independent 28 volt busses each having:**
  - **PV panels**
  - **Charge controller / regulators**
  - **Silver cell batteries for night time operation**
  - **Switchable at the system level for load balancing**
  - **Lithium battery backup for critical systems**
- **"LDB Support Systems" power and "Science Instrument" power systems are NOT shared**
- **NSBF LDB Support Systems and Science Instrument Systems Electrically Isolated**

Balloon Control Systems

- Two independent / redundant flight termination systems
- Helium Valve Control Stack
- Parachute Separation Stack
- All commanded via direct LOS UHF or via SIP AART bus
- Polled Housekeeping Status and Sensor Instrument Decks On Each Stack

Current LDB Mission Model and Methods of Operation

- Two campaigns per year with two flights per campaign...
- One campaign in the Southern Hemisphere during DEC-JAN...
  - » Antarctica / Or
  - » Australia to Brazil
- One campaign in the Northern Hemisphere during JUN-JUL...
- Up to 21 days flight duration...
- Dry impact / recovery...
- Flights can be supported simultaneously

Ground Stations / Tracking / Control

- **Payload Operations Control Center @ NSBF, Palestine, Texas**
  - » **TM/Commanding except LOS**
  - » **Science Interface for data/commanding**
  - » **Flight Operations Control**
  - » **TDRSS POCC**
- **Remote Operations Control Center**
  - » **Located at Launch site**
  - » **Also used for recovery & down range sites as required**
  - » **Supports launch phase operational control**
  - » **Science Interface for data/commanding**
- **Aircraft Flight Termination / Recovery**
  - » **Portable station with LOS and INMARSAT TM equipment**
  - » **Executes flight termination & recovery operations**

MISSION OPERATIONS
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WALLOPS FLIGHT FACILITY

- **Launch Locations**
  - **McMurdo, Antarctica (Science Wt. Limit 3000 lbs.)**
  - **Fairbanks, Alaska (Science Wt. Limit 2500 lbs.)**
  - **Alice Springs, Australia (Science Wt. Limit 2000 lbs.)**
  - **Trajectories +/- 10 degrees (nominal) latitude of launch site**
- **Payloads**
  - **Instrument and gondola structure provided by scientist.**
  - **Integrated with NASA support systems at NSBF Palestine prior to shipment to launch site.**

Climatological Wind Speeds At 120 KFt

(-) Sign = Towards the West

McMurdo, Antarctica (76 Deg. So. Lat.) Persistent Wind Flight Window (Nov 20 - Feb 5) = 78 Days

	NOV	NOV	NOV	DEC	DEC	DEC	JAN	JAN	JAN	FEB	FEB	FEB	MAR	MAR	MAR
	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31
U COMPONENT (kts)	-12	--1	-18	-12	-16	-17	-14	-12	-13	-10	-7	-1	4	17	22
STANDARD DEVIATION	5	5	21	9	4	6	6	5	8	4	11	9	8	11	14

Fairbanks, Alaska (65 Deg. No. Lat.) Persistent Wind Flight Window (May 10 - Aug 10) = 92 Days

	APR	APR	APR	MAY	MAY	MAY	JUN	JUN	JUN	JUL	JUL	JUL	AUG	AUG	AUG
	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-31
U COMPONENT (kts)	-1	-12	-14	-14	-14	-20	-22	-30	-32	-31	-30	-22	-18	-9	2
STANDARD DEVIATION	18	32	20	11	13	12	11	5	3	4	5	3	4	5	5

Alice Springs, Australia (23 Deg. So. Lat.) Persistent Wind Flight Window (Nov 20 - Mar 20) = 121 Days

	OCT	OCT	OCT	NOV	NOV	NOV	DEC	DEC	DEC	JAN	JAN	JAN	FEB	FEB	FEB	MAR	MAR	MAR	APR
	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10
U COMPONENT (kts)	-3	-12	-12	-16	-27	-34	-46	-50	-56	-64	-67	-71	-68	-63	-51	-41	-35	-16	1
STANDARD DEVIATION	15	20	18	12	13	11	12	10	10	11	10	11	10	10	18	11	12	11	14

Christchurch, New Zealand (43 Deg. So. Lat.) Persistent Wind Flight Window (Nov 25 - Mar 5) = 101 Days

	NOV	NOV	NOV	DEC	DEC	DEC	JAN	JAN	JAN	FEB	FEB	FEB	MAR	MAR	MAR
	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31
U COMPONENT (kts)	5	-6	-15	-28	-34	-44	-47	-52	-50	-49	-41	-32	-17	-12	1
STANDARD DEVIATION	11	9	11	9	9	8	8	7	7	8	9	7	8	9	8

ULDB Areas for Study and Planning

- **ULDB Mission Operations**
  - **Launch Operations and Methods**
  - **Flight Operation Tracking / Control**
  - **Recovery Operation**
  - **Safety**
  - **International Coordination**
  - **Inter-Agency Coordination**
  - **Launch Sites**
  - **Launch Vehicles**
  - **Facilities**
  - **Flight Planning and Meteorology**

MISSION OPERATIONS
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WALLOPS FLIGHT FACILITY

- **ULDB Requirements Impacting Mission Operations Methods [1]**
  - » **Mid-Latitude and Polar Trajectories**
  - » **Flights tracked continuously from a central ground station**
  - » **Trajectory forecasts maintained and continuously updated / improved wind predictions**
  - » **Real-time data & commanding at Launch Site, Central Ground Station and PI Institution**
  - » **Payload recovery desired but not required**
  - » **Re-flight of preemptive terminations**
  - » **Aircraft for termination / recovery operations**
  - » **Feasibility for recovery operations for water impact**
  - » **International coordination and technology transfer**
- **Next Step: Develop Mission Operations Concept [1]**

[1] Ultra-Long Duration Balloon (ULDB) Program Study Interim Report; April '97; GSFC Study Team.